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METHOD OF TREATING AND PIPELINING OF CRUDE SHALE OIL-COAL SLURRIES

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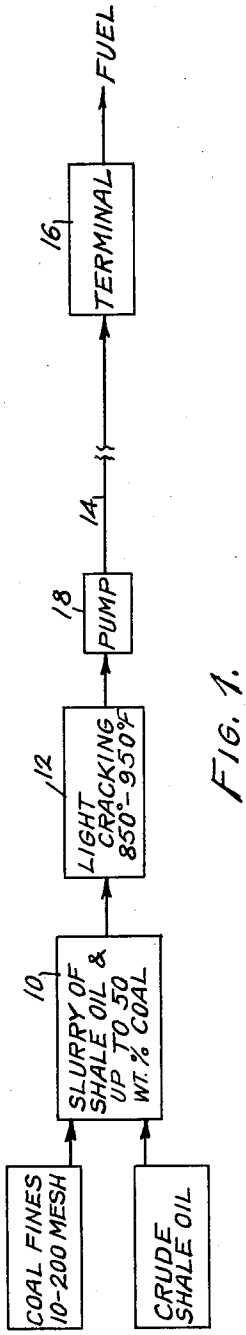


FIG. 1.

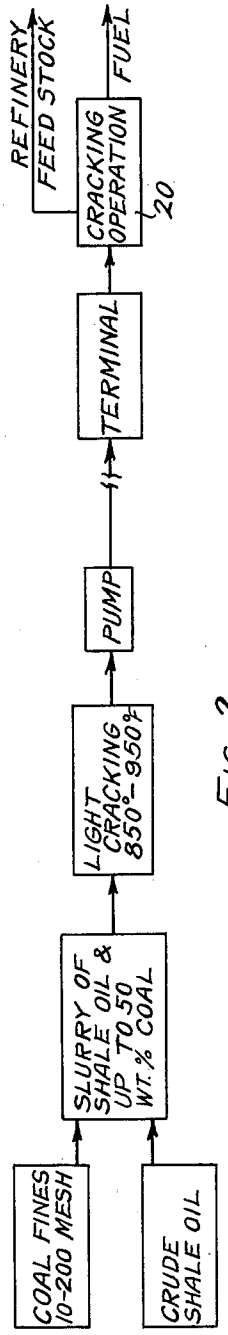


FIG. 2.

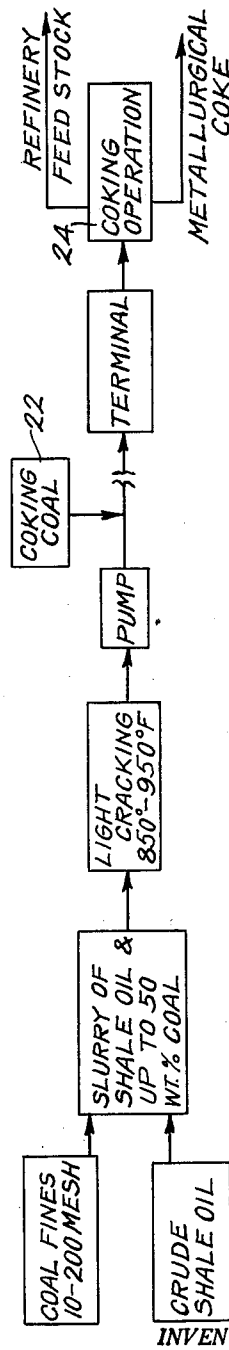


FIG. 3.

INVENTOR.

RUSSELL J. CAMERON

BY

Anderson, Spangler & Wymore

ATTORNEYS

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METHOD OF TREATING AND PIPELINING OF CRUDE SHALE OIL-COAL SLURRIES

Russell J. Cameron, Denver, Colo., assignor to Cameron and Jones, Incorporated, Denver, Colo., a corporation of Colorado

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This invention relates broadly to the pipelining of crude shale oil-coal slurries and more particularly to a method of treating such a mixture to render same susceptible to the economical pipeline transportation thereof with maximum utilization and economy at destination.

Crude shale oils have, for the most part, a relatively high wax content and require treatment to reduce the pour point and viscosity thereof. One such treatment, known in the art as "viscosity breaking" or "visbreaking," is a pyrolysis treatment of the oil which has as its purpose the destruction of waxes and high molecular weight constituents to reduce the viscosity and pour point of the crude to limits suitable for economical pipeline service. In the absence of visbreaking or other processing of a crude shale oil having a high wax content, the attendant high pour point and viscosity presents difficulties in pipeline service. Even when pressures near the maximum permissible for standard pipe and pumping equipment are employed, unprocessed crude shale oils, due to their relatively high wax content, would require special pumping procedures and the addition of heat to the line to prevent plugging of the pipe and equipment.

The use of coal as a source of energy has not been widespread in certain locations due to the expense of transporting the coal from the coal deposit to the point of utilization. The normal method of transportation is by rail and in certain parts of the country, rail transportation is prohibitive for coal in relation to the cost of other fuels. Similarly the cost of shale oil has not been competitive heretofore with the petroleum oils.

The cost of petroleum oils has risen and is rising due to many factors, not the least of which is availability. It has been determined that if the delivered cost to energy ratio of coal and/or shale oil were improved, they would be competitive with other fuels, such as petroleum oils and gas, as a source of energy, refinery stock and the like and would open new and previously unavailable markets. It has now been found that where coal deposits are in proximity to shale oil sources, a slurry of the coal can be transported in the shale oil at a lower cost than conventional transportation of the coal.

It is an object of the present invention to provide a method of treating crude shale oil and coal mixtures to render same suitable for pipeline service and to provide a more economical means of transporting coal which in essence pays its own way.

A further important object of the present invention is to provide a method of treating crude shale oil and coal mixtures which produces a product that can be transported by pipeline and which at the destination may be suitable for use as fuel, refinery feed stock or additionally as a source of metallurgical coke depending on what, if any, treatment is given to the pipeline delivered product.

A still further important object of the present invention is to provide a method wherein finely divided coal is slurried with crude shale oil and the slurry is subjected to a pyrolysis step in situ to visbreak the shale oil and at the same time release liquid products from the added coal to produce a resulting mixture suitable for pipeline service.

Another important object of the present invention is to provide a method of treating a shale oil-coal slurry to render same suitable for pipeline service, transporting the treated slurry as by pipelining and processing the transported slurry to selectively produce a refinery feed, metallurgical coke and/or fuel.

Another object of the present invention is to provide a method of treating finely divided coal in situ with crude shale oil to release liquid products from the coal and viscosity break the shale oil, transporting the treated mixture, adding further amounts of finely divided coal of predetermined characteristics to the mixture in transit and processing the delivered mixture to provide a selected end product such as a metallurgical grade coke and the like.

For a better understanding of the present invention, together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

In the drawing:

FIGURE 1 illustrates diagrammatically a flow sheet of one embodiment of the process according to the present invention;

FIGURE 2 illustrates the flow sheet of another embodiment; and,

FIGURE 3 illustrates still another embodiment of the invention.

Typical crude shale oils which may be used in the process of the instant invention are shown in Table 1 as taken from the Bureau of Mines Report of Investigations 4898 entitled Analysis of Crude Shale Oil, by R. F. Stevens, G. U. Dinneen and John S. Ball, published by the United States Department of the Interior in August 1952, on pages 10–14.

TABLE I

Crude Shale-Oil Analyses

Source	Eduction Method & Retort	Sp. Gr.	API	Pour Point, ° F.	Viscosity, S.U.S. @ 100° F.
1. Rifle, Colo.	N-T-U	0.935	19.8	90	280
2. Rifle, Colo.	Gas Comb	0.943	18.6	85	310
3. Rifle, Colo.	Pumpherston	0.900	25.7	60	50
4. Rifle, Colo.	Gas Flow	0.959	16.0	70	660
5. Rifle, Colo.	Royster	0.936	19.7	90	230
6. Rifle, Colo.	Parry	0.931	20.5	70	155
7. Rifle, Colo.	Union Oil	0.945	18.2	75	280

It is necessary with shale-oil crudes, as with some petroleum oils, to reduce the viscosity and pour point of the crude before it can be economically transported by pipeline. Viscosity breaking, a mild once-through cracking operation, is a convenient means of producing a crude of a sufficiently low pour point and viscosity to permit transfer by pipeline. The viscosity breaking is normally carried out at about 850° F. to 950° F. at atmospheric pressure and the viscosity-broken crude may be processed thermally at the pipeline terminal to produce virtually the same products as could be produced from the original crude.

It has been determined that the requirement of pour points of oils suitable for transfer by pipeline will vary according to the temperatures to which the pipeline is subjected. In a cold climate, a pour point below about 25° F. is satisfactory while in warmer climates a pour point below about 50° F. may be tolerated. Oils having a pour point up to about 50° F. may be successfully transferred by pipeline depending on the climatic conditions. An oil having a viscosity range of up to about 150 S.U.S. at 100° F. can be transferred and pumped through a pipeline feasibly.

It has now been found that if an amount of finely divided coal having an amount of releasable liquid products is slurried with a crude shale oil and the mixture subjected to a viscosity breaking process, a product will result,

due to the action of the viscosity breaking of the crude and the release of liquid products from the coal, which can be readily transferred economically by pipeline using standard techniques to provide a product at the pipeline terminal which may serve as a source of fuel or be further treated to produce additionally a refinery feed stock and/or other products.

More specifically applicants novel process includes the steps of admixing coal fines of from about 10 mesh to about 200 mesh in a crude shale oil in an amount of up to about 50 weight percent of the slurry, subjecting the slurried coal in shale oil to a light cracking temperature for a time sufficient to viscosity break the shale oil and effect a carbonization of the coal releasing liquid products therefrom. Cracking of the coal-shale oil slurry at temperatures of from about 850° to about 950° F. while containing from about 40 to 50 weight percent of coal fines of a coal which will release from at least about 5% to 10% liquid products based on the weight of the coal will provide a coal-shale oil slurry having a pour point below about 25° F. and significantly below about 50° F. with a viscosity below about 150 S.U.S. at 100° F. It will be appreciated that the amount and composition of the coal added should be such that the liquid product released from the coal at the cracking temperatures is sufficient to substantially offset the increase principally of viscosity and to a lesser degree the pour point of the cracked mixture resulting from the coal addition. A maximum of about 50 weight percent of a coal of the 10 to 200 mesh size is indicated in the instant invention since the viscosity of the cracked slurry increases more rapidly with the addition of coal above this figure than it is possible to offset with the released liquid coal products and products resulting from the visbreaking of the shale oil.

The product resulting from the light cracking step, having a pour point below about 25° F. and significantly below about 50° F. with a viscosity below about 150 S.U.S. at 100° F. is suitable to be transferred by pipeline using ordinary techniques. At the pipeline terminal, the transferred slurry may be treated as by further cracking and/or distillation to provide products suitable for use as a fuel as well as feed stock for a refinery and the like. Thus it is seen that the coal in essence has been given a free ride, since the liquid products released therefrom are recoverable in the refining operation.

In addition to the processing, pipeline transporting and terminal treating of the coal-shale oil slurry, this invention further contemplates the addition of coal fines at intermediate points for such purposes as that of providing metallurgical grade coke by proper treatment at the pipeline terminal.

Referring to the drawings, FIGURE 1 represents diagrammatically one embodiment of applicant's novel process. Finely divided coal in the range of from about 10 to about 200 mesh is slurried in crude shale oil in an amount not to exceed about 50 weight percent of the slurry as indicated at reference numeral **10**. The mixture is then subjected to a light thermal cracking in a cracking unit **12** subjecting the slurry to a cracking temperature of from about 850° F. to about 950° F. for a period of time sufficient to viscosity break the shale oil and to release liquid products from the coal. The product resulting from the cracking operation is then introduced into a pipeline **14** and moved to a terminal point **16** by suitable means such as pump **18**, and the like. At terminal **16**, the transported product may be distributed for ultimate use as fuel.

FIGURE 2 illustrates a process similar to that of FIGURE 1 but includes a further cracking and/or distillation step as at **20** to provide a fuel product and a refinery feed stock which is suitable for the usual refinery operation.

FIGURE 3 illustrates still another embodiment wherein a coking or semi-coking coal product is introduced into the pipeline as at **22** intermediate the origin and terminal of the pipeline. The product delivered to the pipeline terminal is subjected to a cracking and/or coking operation as at **29** to provide a refinery feed stock and/or metallurgical grade coke. The shale oil, when coked, will yield from about 10% to about 20% of a pitch or coke and additional amounts are available from the coal additives. The slurry can be fed directly to coking ovens to produce coke with the light oils resulting from the coking step being a mixture of coal tar products and shale oil cracking products and is suitable as refinery feed stock.

It will be appreciated that the amount of liquid products resulting from the carbonization of the coal will, to a certain extent, determine the upper limit of the amount of coal that can be added to a particular shale oil. The viscosity breaking of the shale oil will also accommodate a portion of the coal added. It has been found that about 50 weight percent of coal represents a practical upper limit. Lesser amounts of coal may be used where the amount of liquid products dictates. The addition of coal above about 50 weight percent produces a rapid rise in viscosity of the mixture and would add rapidly to the pumping problems.

It will be noted that while it is desirable to produce a pour point of the slurry of below 25°, in warmer climates, a pour point range of up to 50° F. can be tolerated without serious adverse effect.

It will be appreciated by those skilled in the art, that while the treatment of shale oil is given by way of example, applicant's novel procss is equally applicable to petroleum oils that would require a visbreaking operation and release of liquid products from a finely divided coal slurried therein to render such slurry acceptable for normal pipeline service.

While there have been described what at present are considered to be the preferred embodiments of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention. It is aimed, therefore, in the appended claims to cover all such changes and modifications which fall within the true spirit and scope of the invention.

What is claimed is:

1. The method of pipelining crude shale oil and coal slurries comprising: admixing a substantial amount of finely divided coal with shale oil up to about fifty percent coal based upon the shale oil, said coal having a particle size in the range of about 10 to 200 mesh; thermally cracking the coal and shale oil admixture in the range of from about 850° F. to about 950° F. for a period of time sufficient to viscosity break the shale oil and to carbonize the coal releasing liquid products therefrom to produce a pumpable slurry of coal and shale oil; transporting the said pumpable slurry via a pipeline to a terminal point; and, cracking the said slurry at said terminal to provide as products a refinery feed stock and a fuel.

2. The method as defined in claim 1 wherein: a finely divided coking coal is added to the said slurry to provide a combined total of coal which does not exceed about 50 percent by weight of said slurry and, wherein the cracking step at the said terminal produces a metallurgical grade coke in addition to a refining feed stock and a fuel.

3. The method of pipelining crude shale oil and coal slurries comprising: admixing a substantial amount of finely divided coal having a particle size of from about 10 to about 200 mesh with shale oil having a pour point in excess of 50° F. and a viscosity in excess of 150 S.U.S. at 100° F., said coal present in the admixture up to about 50 percent based upon the shale oil; thermally cracking the coal and shale oil admixture in the range of from about 850° F. to about 950° F. for a period of time sufficient to viscosity break the shale oil and to carbonize the coal releasing about 5 percent to about 10 percent of liquid products based on the weight of the coal to produce a pumpable slurry of coal and shale oil; transporting the said pumpable slurry via a pipeline to a terminal point;

and cracking the said slurry at said terminal to produce refinery feed stock and a fuel.

4. The method as defined in claim 3 wherein the slurry piped to a terminal is coked to produce coke and a refining feed stock.

5. The method as defined in claim 3 wherein a finely divided coking coal is added to the said slurry to provide a combined total of coal which does not exceed about 50 percent by weight of said slurry and, wherein the resulting slurry is coked to produce a metallurgical grade coke and a refining feed stock at said terminal.

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